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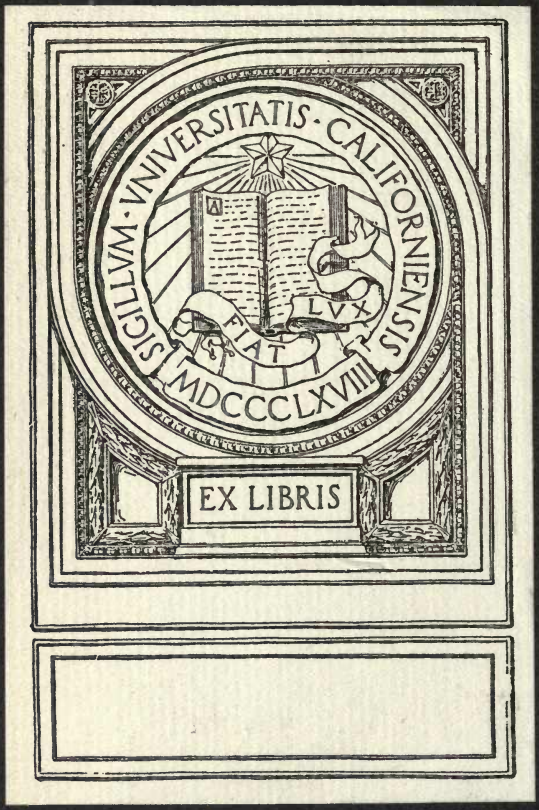
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Securing high efficiency of pier or quay walls in loading or discharging miscellaneous cargoes.

(being N° 15 of the series of Questions submitted for consideration.)

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REPORT

BY

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UNIVERSITY OF CALIFORNIA
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Securing high efficiency of pier or quay walls in loading or discharging miscellaneous cargoes.

High efficiency may be said to consist in obtaining great rapidity with economy in the freight movements at Marine Terminals.

To secure this rapidity means absence of congestion from the beginning to the end of movements between the vessel, shed, car or other terminal elements.

To prevent congestion there must be not only freedom from interference, from delay or rehandling, but there must also be ample holding space within the shed or other places of freight storage.

At the Port of Hamburg the following is the latest practice for the width of quay-wall sheds; that, *the modern sheds should be 200' in width, in order that the goods taken from* **one ship** *may be distributed* **opposite** *to it, for further treatment.*

The same conclusion, but extended in its scope, had already been deduced from a study of the great capacity obtained by high tiering by the transporting machinery.

Simplicity. — By extending this principle of having sufficient holding capacity of sheds opposite each ship to projecting pier-sheds, with *two* ships, one upon each opposite side of the pier, and for holding outbound as well as the inbound freight, and the width of shed not limited to 200', as upon the Hamburg quays, but planned according to the length of the pier, the operating conditions and high tiering, there is attained a still further simplifying of previous terminal layouts.

The practical result of this is, that where Gantry Cranes are installed, the longitudinal track loop from one end of the pier shed to the other can often be omitted, unless connection is to be made with remote warehouses. With such requirements it can be easily added. That portion of the angle-projecting-pier or the parallel quay, opposite the ship or ships, with high tiering from movable

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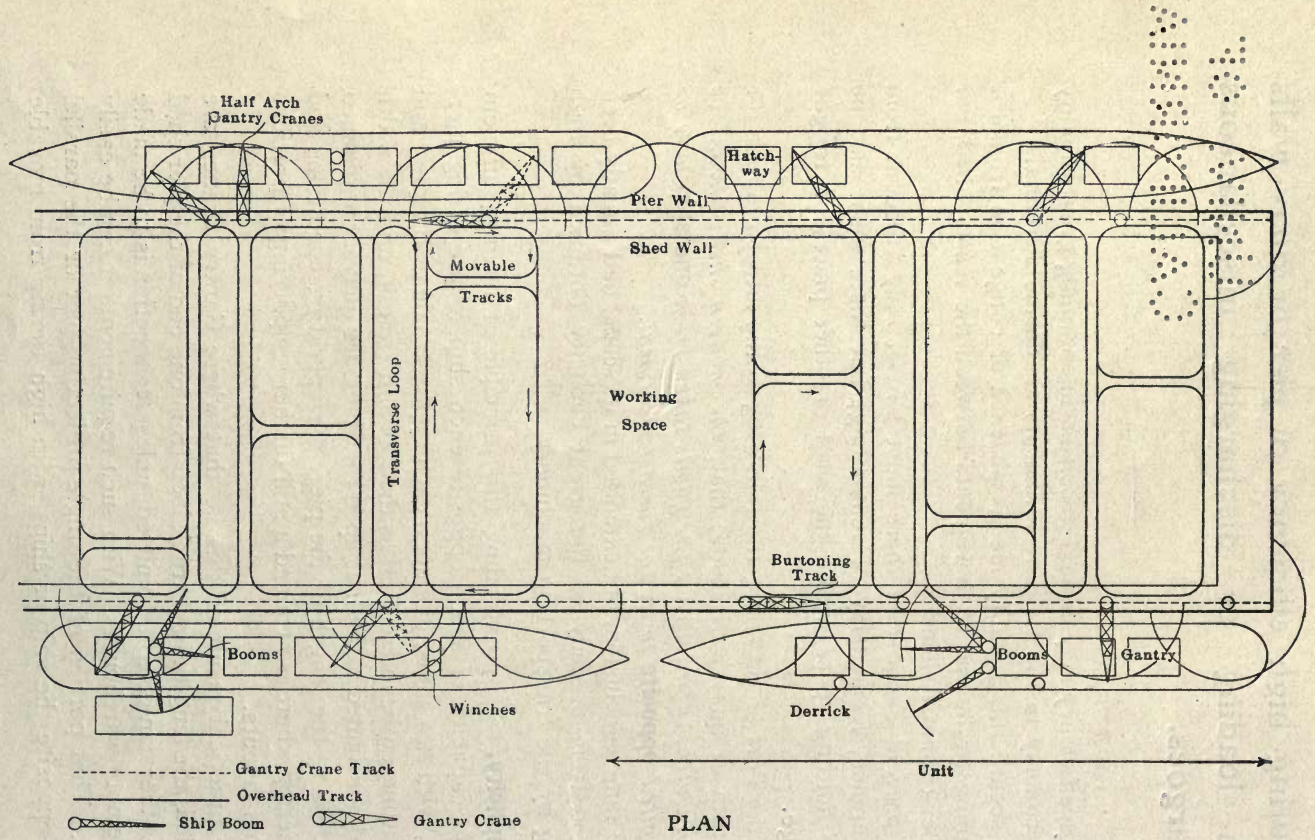
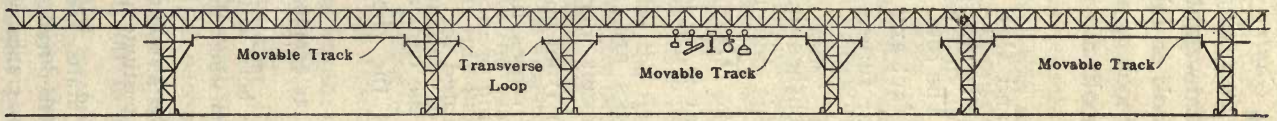
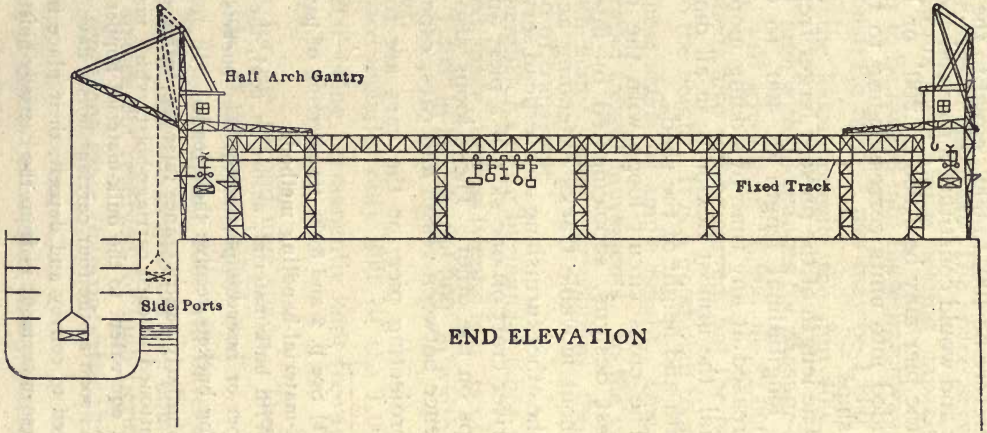

Half Arch
Gantry Cranes
Hatch-
way
Pier Wall
Shed Wall
Movable
Tracks
Transverse Loop
Working
Space
Burtoning
Track
Booms
Winches
Derrick
Booms
Gantry
Gantry Crane Track
Overhead Track
Ship Boom
Gantry Crane
Unit

PLAN



SIDE ELEVATION



END ELEVATION

tracks, will be sufficient for all trans-shipment operations and temporary holding capacities. The long reaching *Gantry Cranes* serve the cross loops opposite the ships by direct *burtoning*.

Burtoning consists in transferring the draft, or the weight of the draft, without stopping or lowering, from one hook or fall rope to another, as from the hook of one boom to the hook of another boom, or from the hook of a Gantry Crane to the hooks of carriage hoists. (1)

Unit of Capacity. — One unit of pier length and shed would therefore be 400' to 600', equal to the length of the larger freighters and would constitute a pier and shed in itself. The total length of the pier may be 1,000', 1,200', or 1,500', or in fact any length divided into units corresponding to the present or future length of ships.

The length of the present larger freighters establishes this unit, the longitudinal length of 400' to 600', and this unit can be increased at any time by adding more cross loops. There is, as usual, the utmost flexibility in all dimensions, that is, in length, width and height of the sheds.

The cross circuit loops with the movable tracks are, in the latest designs, supplemented by intermediate circuit loops but without movable tracks extending across the pier from one side to the other furnishing an overhead service between barges, lighters or river craft on one side of a pier, and the outgoing or incoming ships on the other. These loops also can be adapted for transference between vessel and cars, especially when the cars are on a projecting pier, or the cars are to the rear of the sheds on

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(1) See p. 2 and 3 the transferring of package freight, as adapted from bulk-material-handling methods.

With bulk-material, as ore or coal, the gantry cranes hoist and fill a hopper or reservoir possibly of four buckets capacity, from which the conveying buckets receive their loads.

Similarly gantry cranes raise the drafts, one of which for a train of four is burtoned to each carriage-hoist, which may be said to constitute a reservoir, equivalent to the bulk-material hopper.

As soon as the four carriage-hoists have received their drafts, and have started to convey and deposit, their place is filled by another train. The reverse movement is from the carriage-hoists to the gantry cranes.

parallel quays. On quays the transverse or other loops can be extended to the rearward warehouses, yards or dray areas.

Range of Cranes. — By the long outreach of the Gantry Cranes, all these loops can be served from hatchways or from side-port-gang-planks by one or more Gantry Cranes.

Goods from all the hatchways or side ports of a ship or from other vessels can be mechanically assorted, distributed and tiered within this unit, or space of the movable and transverse track loops opposite the ship, as well as from the hatchways of another steamship on the opposite side of the pier. The space served by the loops opposite hatchways have ample holding capacity for goods discharged from, or to be loaded into these hatchways.

A few figures will demonstrate this. A pier may be 1,000' long, 300' wide. The space in the loops opposite the ship 400' long, tiering on the average, 20' high with allowances for passage-ways, columns and free spaces, will give from 26,000 to 32,000 tons capacity. Low studded sheds also can be served, but the holding capacity is proportional to the height. It is a good plan to always make the first story of new sheds of ample height. One story sheds are preferable for rapid freight movements. In the case of narrow piers or those with many supporting columns, the loops can be longitudinal instead of transverse.

As the usual average height of tiering by manual labor is five feet, this 400' loop-covered space, tiering twenty feet, is of itself equivalent to a pier, over 1,400' in length and 300' in width when the tiering is only five feet.

This first unit loop space includes only 400' of the 1,000' of total length of the pier, 200' being permanently kept free for low tiering or for working areas.

Another 400' length is for the second unit space. There are additional spaces at the sides of the pier not included.

This second similar unit also occupying 400' will have an additional capacity of 26,000 to 32,000 tons or another pier equivalent to 1,400' in length. The spaces not reserved for high tiering but called *working areas* can represent more than one-fifth the total length of the 1,000' pier.

Similar package freight is often tiered over thirty-two feet in height in pier-sheds in New York Harbor.

This total of 52,000 to 64,000 tons of package freight or miscellaneous cargo, not including the working area, are in excess of the requirements for temporary freight holding for four ships. The basis of sixty cubic feet per ton, instead of the marine forty cubic feet, was taken. At forty cubic feet per ton, the total capacity would be over 78,000 tons. Fifteen feet tiering, would give three quarters of the above capacity. By the width of the pier being 200' instead of 300', there would be storage for about 34,000 to 42,000 tons. Although a portion of the cargo will not be held upon the pier, yet there should be provision for the maximum.

The Operations. — The operations of discharging, consist in having one to two Gantry Cranes lifting plainly marked drafts from each hatchway and burtoning to carriage hoists (traveling winches), suspended from the designated overhead loop. One draft of more than one mark may be divided among the four carriage hoists of one train for assorting before distribution. The tractor-man only travels around an around his own loop circuit, there being no switches or cross tracks for him to open or close. Loading is even a simpler operation than discharging, as, without any assorting and distributing, the full-weight loads are burtoned from the carriage hoists of the overhead loop tracks, which project just beyond the shed line, to the Gantry Cranes or ship's winch and by them lowered directly into the hold. The movable tracks usually operated by the floor hook-man enable every cubic foot of space between the side loop tracks to be served.

The speed of transference is only limited by the number and capacity of gantry cranes, as the capacity of the carriage hoists, by adding to their number, can be kept in excess of that of the cranes. This overhead layout and the method of operation, there being no switches in the overhead trackage, is of the utmost simplicity and permits the freest rapidity. Burtoning from one boom to another, or from the boom to a side derrick or to a cargo hoist is employed by about every freighter in New York harbor.

The Mechanism. — The ship's stationary winches, derricks and burtoning booms can be used either separately, or in conjunction with, and supplementing the gantry cranes. The gantry cranes

can be of the *full arch, half arch* or *roof type*, or what is called the *walking gantry crane*, the latter being adapted to canal terminals. The special object of this layout was to secure the greatest rapidity in loading and discharging, and increased terminal holding capacity. By making one terminal equivalent in service to two, there is no small saving effected in the terminal investment. The overhead tracks are fixed and movable. There are trains of four carriage hoists and the tractor. No new types of machinery or operating conditions are involved.

Loading and Discharging Capacity. — Each gantry crane of greater capacity than hitherto employed, can transfer in its cycle from 50 to 200 tons per hour. With sufficient hatches, two cranes at each hatch, there would be a capacity of 400 to 1,600 tons per hour, varying greatly according to the character of the cargo and the type of vessel. Each train of carriage hoists in loading has for its average cycle nearly the same capacity.

In discharging, due to assorting and distributing, the capacity is less depending upon the number of marks. Only one mark in discharging is tranferred by each carriage hoist.

CONCLUSIONS :

First: — *that on that portion of projecting piers or quays opposite each ship or ships, there should be sufficient temporary shed-holding-capacity for the incoming and outgoing cargoes with ample working floor space, it, therefore, not being necessary to assort and to distribute outside this space.*

Second : — *that this capacity is practically and economically attained by mechanical high tiering from overhead movable tracks.*

Third : — *that it is possible to transfer continuously between vessel and shed, vessel and vessel, vessel and cars, in either direction, serving cubic space, without rehandling, interference and congestion.*

Fourth: — *that by a combination of the Gantry Crane or the ship's winch or both, with overhead tracks, fixed and movable, equipped with trains of tractors and carriage hoists, and by burtoning, there*

is attained the most important factor in terminal freight movements, namely, the utmost possible rapidity in discharging and loading the greatest tonnage including mechanical assorting, distributing and tiering, and that this results in a high efficiency of the pier or quay walls.

H. Mc L. HARDING.

New York, Oct. 13th 1913.

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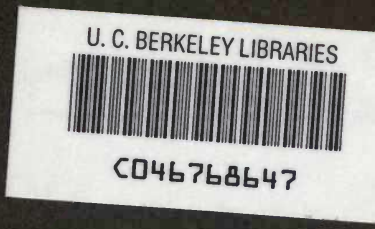

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